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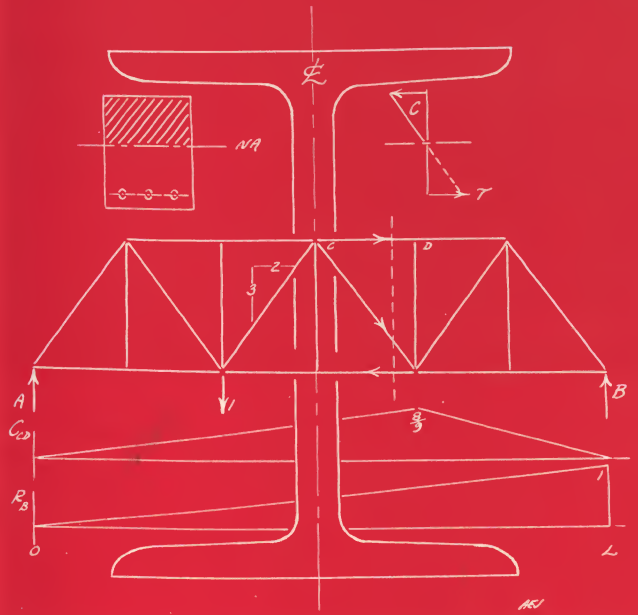
THE GEORGE WASHINGTON UNIVERSITY - SCHOOL OF ENGINEERING



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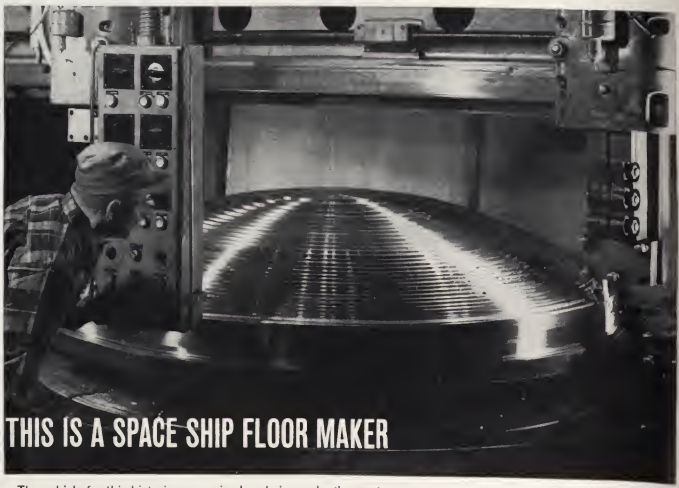
THE GEORGE WASHINGTON UNIVERSITY

DECEMBER 1960

Sometime within the next several years, the first American will soar into orbit around the earth. He will be sealed in a small, cone-shaped space capsule mounted atop an Atlas missile. The missile will climb 100 miles in less than six minutes, where the capsule will disengage and go into orbit. The man will be alone in space.



THIS IS A SPACE SHIP FLOOR MAKER

The vehicle for this historic voyage is already in production under the auspices of the National Aeronautics and Space Administration's "Project Mercury." One of the methods of heat protection is a beryllium heat sink, forged on two giant steel dies. Both dies are USS Quality Steel Forgings. The top die (shown being rough-machined on one of our vertical boring mills) will be convex, 20 inches thick and will weigh 26,520 pounds. The bottom die, concave and 18 inches thick, weighs 27,700 pounds. Both are 92 inches in diameter.

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"What's going on here?" *See page 20.*

source, and generator and impeller have been flight tested. The approach has been to determine if sufficient light could be obtained by using small incandescent lamps, and further, to determine if the lamps and generators could withstand the acceleration encountered when installed in the tips of the rotor blades. It was thought that these parameters should be resolved first, after which attention could be directed to devising a method of remotely switching the lights for those flights when they are not required.

Construction of the equipment is as follows: The light source consists of four type CM-680 incandescent lamps embedded in a small panel of clear plastic. The underside of the panel is painted white to reflect the incident light flux out of the top. The lamps were selected because of their small size and relatively long life under normal operating conditions. The lamps are actually about 1/8" in dia. and about 1/4" long. They are rated at 5 volts, 60 milliamperes, and when operated at this voltage the luminous output is about 0.04 spherical candle. Life of the lamps at this voltage is exceedingly long. These are special lamps which are designed for use in sealed aircraft instruments where the life of the lamps must be greater than the usefulness of the instrument itself.

Figure 2 – Photograph of helicopter blade tip equipped with an early model air-driven generator light system.

For the helicopter application, the lamps are operated at about 8.0 volts which produces about 0.3 spherical candle per lamp. Sixteen lamps are used on the helicopter (four per blade). Assuming light losses in the fixture from absorption, reflection, and transmission to be of the order of 50%, this produces about 30 lumens of flux in the light ring. When this flux from the four fixtures is spread out over the entire circle a brightness of one to two footlamberts is obtained. Accelerated life tests of the lamps indicate that when operated at 8.0 volts under normal conditions the life would exceed 5000 hours. The effects of centrifugal tests upon the lamps revealed that the filament coils of the lamps stretched under the high accelerations encountered. It is significant, however, that there were no lamp failures. Once the coil makes contact with the glass envelope, further moving and stretching is apparently restricted. Figure 1 is a photograph of the filament of a lamp after being subjected to the accelerations indicated. For comparison the filament of a lamp which was not tested is also shown. The photograph shows the filaments enlarged about 25 diameters. A group of lamps, whose filament coils were measured before and after the centrifugal tests, showed an increase in length averaging 0.02 inch as measured from the filament supports to the apex of the coil. Before the test the average length was 0.061 inch as compared to 0.081 inch after the test. Filament current at the same time increased from an average of 0.079 ampere per lamp to 0.082 ampere. This slight increase in current is not considered serious.

It might be well to point out at this time some of the characteristics of the helicopter on which this equipment is used. The helicopter rotor blade span is 56 feet. Under normal cruise conditions, the blades have a pitch of 8° and rotate at approximately 220 RPM. This radial velocity corresponds to about 650 linear feet per second at the tip where the acceleration is about 470 G's. For practical purposes linear speed is considered equivalent to air speed. The maximum acceleration ever expected would be about 560 G's corresponding to 240 RPM of the rotor. For testing purposes, an acceleration of 600 G's is considered the design minimum.

Alternating current generators with permanent magnet rotors are used to supply power to the lamps. These generators are rated at 7.4 volts, 2.5 watts when driven at approximately 9000 revolutions per minute. Each generator weighs about 2-1/4 ounces. They incorporate special thrust bearings selected to withstand the high accelerations which are produced when the mounting position of the generators in the blade tips is such that the acceleration is parallel to the shaft of the generators.

Each generator is driven by a vaned wheel impeller attached to its shaft. The generator is mounted inside the blade-tip of the helicopter in such a manner that the lower vanes of the wheel protrude through an opening in the under surface of the tip into the air stream. Installation of the light and generator assembly is shown in Figure 2. In operation, air impinges on the protruding vanes and drives the generator armature, thus furnishing power for the lamps.

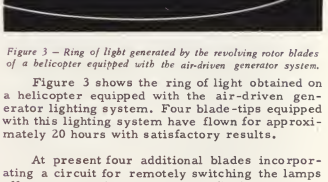

Figure 3 – Ring of light generated by the revolving rotor blades of a helicopter equipped with the air-driven generator system.

Figure 3 shows the ring of light obtained on a helicopter equipped with the air-driven generator lighting system. Four blade-tips equipped with this lighting system have flown for approximately 20 hours with satisfactory results.

At present four additional blades incorporating a circuit for remotely switching the lamps off or on are being prepared for field evaluation.

Part II -- The Significance of Wireless During The Titanic Tragedy

By Donald C. Lokerson E.E. '62

The Lessons Learned From the Collision

Now that the "facts" have been presented, let's look at the good and the bad points that have been illustrated, taking them in chronological order.

Everyone is agreed that the Titanic disaster could not have been as great a tragedy if the following rules had been more strictly followed. First, the crew of a vessel should participate in regular lifeboat drills, preferably before each voyage. Second, the crew should have an organized method of quickly loading lifeboats not only with passengers, but also with ample numbers of able-bodied seamen to propel the craft and to follow the orders given to them by the Captain. Third, there must be enough lifeboats to hold every person on the vessel. Fourth, reliance should not be placed on watertight bulkheads. Fifth, it must be remembered that no boat is unsinkable!

The hearings on the Titanic disaster have taught us that wireless can increase human agony instead of alleviating it. "We have learned that this new force must be sternly regulated if it is to perform its due service to humanity. It seems that we do not learn from history. In January 1909, the Republic was hit by the Florida off the coast of Nantucket in a dense fog. Both ships were disabled and they drifted apart. The Republic was the only one of the two which had a wireless set aboard. Jack Binns sent the C.Q.D. which brought the Baltic to the sinking ships. This collision should have shown the wireless companies the urgent desirability of having two operators on each boat, and a wireless on every vessel. It was bad enough that the Florida had no means of communication after the collision, but the Coast Station that heard the Republic had only one operator who, kept awake by the cold Nantucket night, just happened to be listening on the wireless at the right time. Luck was the only reason the Baltic operator was awake and listening at the time, so that aid was dispatched quickly.

During the Titanic sinking, "the Carpathia heard the distress call, but only because the single operator had by chance postponed his usual hour of retirement. Another ship (the Californian) which might have come up in time to save all the passengers, failed to receive the call from the Titanic because the operator was asleep. Hence, there is a strong demand for some regulation providing for wireless outfits on freight as well as passenger steamers, and requiring that every passenger-boat carry two (wireless) operators."

The Titanic was the exception; it had two operators because she expected to carry many first and second cabin passengers who would send a large volume of messages via wireless. Some people recommended that if only one operator is on board a vessel, then one of the ship's officers should be capable of reading code with enough precision that he could determine if the vessel was being called or if some craft was in distress. This means that the ship would not be required to have an extra paid man on board. The bridge officer of the Californian knew some code and had tried to listen for the ship (the sinking Titanic) which he had observed firing rockets not ten miles away. He failed to hear anything because he did not know how to turn the set on!

The legislation approved by Congress in 1912, provided that "steamers" in excess of 3,000 tons or carrying over fifty passengers must carry two qualified wireless operators. These arbitrary figures could have resulted in the death of all forty-nine of the passengers when the Tashmoo carried wireless equipment, but no operator. The ship nearly capsized in a storm in the middle of the Pacific with her engines broken down and a leak in the hull. One of the passengers, who knew nothing about wireless, managed to get the old set working, and he called for help, which they received in a matter of hours.

From earlier accounts on page five, it should be emphasized from previous description that only a few of the ice reports that were received reached the bridge of the Titanic. This points out the lack of fast communication between the bridge

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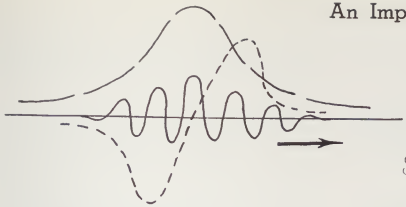

An Implication of The Principle of Uncertainty

By James E. Birdsall E.E.'62

In 1900, physicists began development of a new mechanics which, after sixty years of research, has led to this dilemma. Either science accepts the principle of uncertainty as the sound basis for quantum mechanics or assumes the principle to be a catalyst in the development of a mature quantum mechanics and capable of being discarded in the final analysis of the theory.

For DeBroglie, there is no dilemma as he states:

> "In 1927 Heisenberg made public his indeterminacy relations. His work ... led to a physical interpretation of the new mechanics in which the notion of probability plays a primordial role and which ... ceases to attribute simultaneously a position and a velocity to particles on the atomic scale and refuses to impose a rigorous determinism upon the succession of the then observable manifestations."

This is a clear, concise explanation of quantum mechanics but the contextual meaning of a few terms require clarification before investigating the influence of the principle of uncertainty on the quantum mechanics.

First, the word particle. To most people, this means a solid lump of mass that could have momentum because momentum equals the product of mass times velocity ($G = m \times \nu$). But this particle normally could not have a wavelength because a wavelength is a measure of a non-solid wave. Now a definition of the word wave is energy in undulatory motion cycling from a maximum to a minimum energy level for every time t. This definition not only implies that the measurement of a wave will be in wavelengths but also excludes the application of the momentum concept from wave analysis.

By these macroscopic definitions, one notes that a particle has a momentum but not a wavelength and a wave has a wavelength but not a momentum. These definitions and their described signification have been applied to the microscopic world of quantum mechanics. The two following examples will illustrate if understanding suffers by transferring macroscopic words to the microscopic world.

The first example, taken from classical thermodynamics is the question:

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James E. Birdsall came to George Washington after 3 years, 9 months and 10 days of Navy duty. As a radar operator on a patrol plane he flew 96 patrols over the South China Sea. His only decoration was a black eye which he received while rescuing a case of beer from the Marines in the Philippines.

Mr. Birdsall now works at the Human Resources Research office of George Washington designing radar training aids for the Training Methods Division.

School and work allow no time for hobbies. He is, however, dedicated to the furtherance of education. He spends many of his otherwise free evenings helping grade school teachers broaden their mathematical and scientific backgrounds. The latest report is that he's helping a cute little sixth grade teacher brush up on the decimal system.

If a gas composed of n molecules has a temperature of t degrees, what is the temperature of a molecule of the gas?

The question obviously has no meaning because the temperature is the effect of the summation of the kinetic energies of each individual gas molecule interacting with the recording device (Thermometer).

It is readily seen that the word temperature taken from macroscopic context can not be applied to the microscopic world. But if the word temperature is assumed to be a manifestation of molecular energy then the confusion is removed by stating that an average molecule has n energy units for a given temperature t. The situation is thus clarified by careful manipulation of terms.

The next example, taken from quantum mechanics, emphatically illustrates that although words such as wave and particle have definitions, they frequently absorb each other's defining characteristics.

Let us devise an experiment to record the number of photons hitting a plate after being emitted from a photon gun. If the photons are light waves that follow Lambert's law of waves, then they will be emitted in a 4π radian direction and all will be observed by the recorder. If they are particles in unidirectional flight, then some number less than the total will be recorded.

We observe the number of photons recorded is less than the number emitted. Therefore we state that photons are particles. This appears conclusive except for the disconcerting fact that the energy of a photon is measured by the photon's frequency (energy = h x frequency) which is a defining characteristic of a wave. Again, the macroscopic words - particle and wave - appear to be causing confusion in the microscopic world.

But this type of confusion doesn't exist in the scientist's mind. When thinking of the microscopic world, the scientist does not believe a wave appears as an ocean wave. These words are only cues to bring about the proper response of mathematical relationships. At the very most, these words are used as poor analogies to quicken communication between scientists and to explain difficult concepts to laymen.

Keeping in mind that the quantum world takes black and white definitions and applies various shades of gray to them, let us now attack our problem, the Principle of Uncertainty, with the defined terms as subordinates rather than dictators of our thoughts. Heisenberg's principle may be stated in the following manner:

The range of uncertainty of the position of a particle, multiplied by the range of uncertainty of its momentum, will always be of the order of magnitude of the constant $h/2\pi$. (2)

This statement again contains the words position and momentum and by adding the word uncertainty, physics appears in an entirely new light. The reason being that if a physicist knows the position of a particle, he is able to pinpoint its coordinates (x, y, z) on its trajectory. If he also knows its momentum (mass x velocity) then he also knows its direction of flight. Now if he knows its direction, position and external forces, then it necessarily follows that he can predict the particles future position. This manifests the strongest type of casual relationship, that of determinism.

But, add Heisenberg's word, uncertainty, to the particles position and momentum and accurate prediction of the future is no longer possible. The causal relationship is now of a weaker form, that of temporal order. Today's physicists all agree on this uncertainty explanation. Their difference of opinion stems from the fact that some say this is the foundation of the quantum conceptual scheme while others choose to use the uncertainty relationship as a nonintegral tool for building a more sophisticated construct.

The physicists who believe that the uncertainty principle is an integral part of the new conceptual scheme have many good arguments to strengthen their position. The first as put forth by Niels Bohr is:

> "... As soon as we want to know the momentum and energy of these parts of the measuring arrangement with an accuracy sufficient to control the momentum and energy exchange with the particle under investigation, we shall, in accordance with the general indeterminacy relations, lose the possibility of their accurate location in space and time." (3)

This means that our measuring equipment gets into the act. Every object we choose to call our observer has momentum and by the law of conservation of momentum $((MV)_p + (MV)_o = (mv)_p + (mv_o))$, the observed particle will have a momentum exchange with the observing equipment. Therefore, the very observation of a particle changes its space time coordinates. (x,y, z,t)

The second argument is contained in the principle itself. The rigorous proof of the theory replaces the kinematical and dynamical variables (i.e. velocity) of classical mechanics with symbols of a noncommutative algebra. To quote

--Continued page 9

Heisenberg "The commutation rule imposes a reciprocal limitation on the fixation of two conjugate variables and expressed by the relation:

$$\Delta q \, \Delta p \approx h \qquad (4)$$

We now see that our mathematics, the language of science, does itself require this error of $h/2\pi$. This argument's conclusion becomes a form of a question. Is it possible to rise above our language to broaden our knowledge? In other words can we learn about the unfamiliar without using familiar concepts. These are two arguments for accepting the principle of uncertainty as the basis for quantum mechanics. On the other hand, there are equally simple arguments for the nonacceptance of the principle.

One of these is Einstein's question "Would God play dice with the universe?" thereby alluding to the probability aspect of finding a particle in any one position, at any given time. Because of his reverence for the mathematical certitude in nature's laws, Einstein believed, that someday, scientists would know a particle's path between two observations separated by finite time increments. This belief arises from the fact that past physical schemes, within their own framework, have been certain of nature's ways.

Another very imaginative argument which goes against the grain of most of the physicists is usually framed as a question. Why breathe into these microscopic entities the life and characteristics of macroscopic concepts? For example, if the observed phenomena contains both wave and particle characteristics then give the phenomena a unique name such as wavicle. In other words, use only accepted method and imagination in the unexplored quantum world and suspend judgment on the permanence of the principle of uncertainty.

But even if judgment as to the final worth of the principle is suspended, the dilemma is still here. Perhaps the argument can at least be clarified. A choice has been given to the physicists:

> Either accept the principle as the sound basis for quantum mechanics or assume the principle to be a catalyst capable of being discarded after quantum mechanics approaches maturity.
>
> If the principle is accepted then physics necessarily rejects determinism, the strong causal relation that has proved so fruitful in past scientific endeavors.
>
> If the principle is assumed to be only a catalyst then physical determinism stands and this strong tool of scientific investigation remains intact.

The problem is now in a different light.

> Either determinism is maintained in the methodology of physics or it is discarded, thereby losing a very important weapon of scientific investigation.

The dilemma is still with us and appears just as troublesome. But there is comfort in reviewing the history of physics. In Galileo's time, science was busy collecting confusing data for the giant Newton to formulate his straightforward mechanics.

Then, at the end of the nineteenth century, the genius Einstein constructed his elegant concepts from a mass of conflicting information. Science is again gathering, sorting, and classifying. Soon, someone will take the principle from its questionable philosophical position and place it in the unassuming level of another flagstone which is small but necessary for our stroll through nature.

Paul Farbanish (B.S.E.E., Lehigh '58) is a development engineer with design responsibilities for IBM's new solid state 1401 computer system.

HE'S MAPPING NEW WAYS TO BEAT TRAFFIC JAMS IN LOGICAL SYSTEMS

A computer system must be versatile. The IBM 1401 system, for instance, might go to work in a radiation lab, a stockbrokerage office, an air operations center, a refinery, or any one of a hundred other places. Demands upon the individual units of the system will vary widely.

Paul Farbanish analyzes the loads placed on the system by different applications. One of his assignments is to design new and alternate ways for data to move from unit to unit with the greatest speed and reliability.

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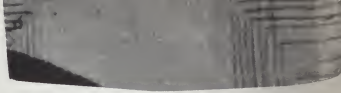

Claudia Cooper, a pretty 20 year old platinum blonde with blue eyes represents the IRE-AIEE as the December "MECH MISS." She is a psychology major in her junior year. Claudia came to George Washington after completing her freshman year at American University. She is a member of Pi Beta Phi.

Claudia lives in Dolly Madison Hall. Her proximity to the Engineering School and the Davis-Hodgkins House has been to the advantage of no engineering students. We've been invaded by law students from the other end of campus boys! Claudia's future plans include one such law student.

Claudia Co

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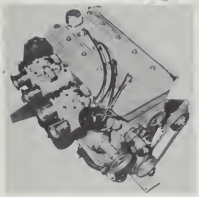
Harold Berlin



With block assembly of welded and brazed stainless steel sheet, the new Taylor-Tyce engine weighs only 175 lbs. and develops 175 hp in its 135 cu. in. version.

Light, Compact, Powerful Unit May Change Traditional Design Concepts

Auto designers and engineers are taking their first look at a remarkable new engine which features a block made of thin, stainless steel sheet.

Designed by Lloyd Taylor, and produced by Tyce Engineering Corporation of Chula Vista, Calif., the four-cylinder engine is sparking discussion among auto experts by its unique combination of higher power, lightness, and durability. For instance, one model of the Tyce/Taylor engine delivers 175 hp, yet weighs only 175 lbs., or one horsepower per pound, thus achieving a long-sought design goal.

To prove its potential under the toughest conditions, the dual overhead-cam engine has been installed in several boats and is scheduled for early test in sports car and racing car competition. Its high performance design is also expected to be welcomed by the military for airborne and ground support equipment.

USES BRAZED THIN GAGE STAINLESS

The main reason for the new engine's amazing performance is its use of brazed, thin stainless steel sheet for the block assembly, including combustion chambers, cylinders, water jacket, intake and exhaust ports, upper block pan, and spark plug tubes. (Brazing might be simply explained as a sort of "super-soldering" that joins metal parts in a strong mechanical and metallurgical bond.)

Tyce Engineering specified a grade of stainless steel known to the metal trade as Type 302. This is a familiar stainless composition employed in everything from pots and pans, to rocket support stands, and building fronts. Besides contributing to the lightness, strength and durability of the Tyce/Taylor Four, the stainless steel construction of the block does away with corrosion worries. Moreover, the thin stainless steel stampings -- (in some sections only the thickness of a penny) -- dissipate heat several times faster than a cast block. As a bonus, the uniform wall thickness eliminates the troublesome "hot spots" which cause pinging in conventional engines.

The use of stainless steel in the Tyce/Taylor engine involves several unique concepts: Special block design eliminates the head gasket and permits very high compression -- up to 14:1. A .063-in. steel liner in each cylinder provides exceptional resistance to wear. The two camshafts, and the crankshaft, can be replaced easily with little effort.

The new engine, which is available in four displacement sizes (91, 105, 120, and 135 cubic inches), can be converted from one size to another simply by replacing the crankshaft to change the stroke. All sizes have the same 3.50-in. bore, all develop maximum power at 6500 rpm.

Several standard parts for Detroit cars, were adopted for the Tyce/Taylor engine — Thunderbird intake and Pontiac exhaust valves, Chevrolet Six valve guides, and Ford Six connecting rods. Several transmissions, including the Corvette 4-speed and the Falcon 3-speed units can be used with the new engine. Special adaptor units permit "swapping" the lightweight, high performance engine into such sports cars as the MG, Triumph, and Austin-Healey.

Weight of the four different displacements is about the same -- 175 lbs. without starter or generator. The 105 cu. in. size will be employed exclusively for midget racing where it will compete with the highly-developed Meyer-Drake engine. The 91 cu. in. size provides increased performance possibilities for inboard racing hulls.

The new Tyce/Taylor four-cylinder engine will be watched closely as it engages in sports and racing car competition and in boats for racing and water-skiing. It already appears to have achieved the long-standing design goal of a light-weight, high performance, practical powerplant for road and marine vehicles.

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These devices are changing the scene at all our manufacturing plants as they go into the startling new communications products developed by our associates at Bell Telephone Laboratories. From microwave transmission equipment to submarine cable amplifiers, our products call for creative production engineering, installation planning, and merchandising methods. Our job for the Bell System and the U.S. government has grown to the point where we are now one of the nation's "Top 11" in industrial sales. And your chance to play an important part in our future growth is *solid!*

Opportunities exist for electrical, mechanical, industrial, civil and chemical engineers, as well as physical science, liberal arts, and business majors. For more information, get your copy of *Consider a Career at Western Electric* from your Placement Officer. Or write College Relations, Room 6105, Western Electric Company, 195 Broadway, New York 7, N. Y. Be sure to arrange for a Western Electric interview when the Bell System recruiting team visits your campus.

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and the wireless "shack". Many other sea disasters of the day showed that this was a common fault of all early wireless installations. The lack of such a vital link can be attributed to the fact that most of the ships were built when wireless was not in marine use, and the apparatus was installed after the ship had been in service many years. The Titanic, however, was designed with the wireless cabin in the original plans. I see no reason why a speaking tube or other type of intercom system was not installed. It certainly would not have cost the White Star Line very much. Much time would have been saved by the Captain in coming to the speaking tube, instead of going back to the radio room to give orders and to find out important information about the ships in the vicinity. Of course ships built about a decade later did provide electronic intercommunication throughout the craft and eliminated the problem. This is probably why no law was drafted to correct the condition.

Soon after the distress call replies were being received by the Titanic, steam was blown off from the boilers. If the operating room had been soundproofed, as the dynamo room was, this outside disturbance would not have hampered radio reception as much. This event points out the desirability for sturdy, soundproof operating cabins.

Under the Berlin radio laws prior to 1912, every vessel that heard the distress call was bound by regulations to report his position and determine if his ship could be of any help. By custom, the ships closest to the distressed vessel made the first replies, but confusion resulted when ships too far away to be of any value (such as the Virginian and Olympic with respect to the Titanic) still were required to report their position. It is interesting to note that it took about a half hour for the ships to determine their positions, to get the order to answer the S.O.S., and to transmit this information to the vessel in distress. In 1912, the law was modified to require only the nearby vessels to report their positions, while other ships were required to continue listening to the distress traffic until the danger was over.

About 11:45 on Sunday, it should be recalled that the Frankfurt wanted details as to the trouble. At the Senate hearings, Bride revealed that it was evident to Phillips that the operator did not know what C.Q.D. or S.O.S. meant. Possible confusion could have arisen because S.O.S. was just beginning to be accepted as the distress call because it was more easily recognized.

The Californian was accused of carrying on irrelevant conversations with other ships in the area during the distress period. These unnecessary signals caused confusion and delay, but I believe the operator did not realize the Titanic was in trouble. He had been asleep through most of the important distress traffic. Congress passed a law forbidding interruption of distress messages by setting up a priority system for radio traffic with distress calls at the head of the list. Violators can be fined.

Soon after that event, the Captain told the wireless operators their duty was done. It is interesting to note that almost every wireless operator who sent out a distress call during this period stayed with his apparatus after being relieved of the duty, and only a few of these men were killed or injured as a result of not abandoning the ship immediately. Also, the extra effort did not usually help rescue attempts because by this time the transmitter was either broken down, or the power supplied to the transmitter was so low that very little signal was radiated.

By Monday April 15, the two frequencies used by radio at that time had become so jammed by ships, government and private coast stations, and radio amateurs, that very little traffic was being relayed by the wireless stations. Thus the need for a new system of frequency allocations was developed. The concept of "bands" or a series of frequencies became segregated regions for each class of station. The government coast stations were assigned very long wavelengths or VLF regions of the "Ether" because the antennas necessary are not practical for mobile use. Private, commercial land stations were assigned slightly higher frequencies. Slightly below the present broadcast band the ships had a set of frequencies. The radio amateurs were given most of the higher frequencies because little was known about them, and few transmitters were capable of transmitting on those high frequencies. By 1916, the new system was checked when the government and commercial stations were requested by the U. S. Government to keep a record of interference, especially from radio amateurs.

The government could enforce its new laws only if it could determine where stations were located. Previously, a new station picked a call from the vast number of those not in use by other stations. There was no easy way of doing this. Since it became almost impossible to determine what calls were in use, the governments of the world decided to assign call letters and to keep on file, the owner and location of the station so that violators of the radio laws could be fined or their licenses suspended. The United States Government decided to give examinations to applicants before issuing a license. Each type of service received distinctive call letters. WOR and KDKA were broadcast stations. KMIS and WF 7847 are marine stations while W1AW (then 1AW) and W3EQB are now amateur call letters. The licenses for each station must be renewed periodically or the call is assigned to another applicant.

--Continued page 18

This system was developed as a direct outgrowth of the Titanic disaster and other tragedies of that decade. The system has been expanded to include new services such as television and radar, but the basic system is in use today.

Until the Titanic disaster, the need for radio messages to be kept secret did not exist. Many amateurs decided to reveal the contents of personal messages they overheard in commercial telegraph channels. As Marconi said after the Titanic sinking:

> "One of the most important developments of the future will be the protection of private messages, within certain limitations. It is necessary that all ships be able to communicate with each other and with shore stations freely."

After the Titanic sinking, the Berlin Conference passed a law to guarantee the secrecy of radio conversation, with the exception of broadcast and distress traffic.

Mr. Ismay, one of the survivors, believed that too much reliance had been placed on wireless telegraphy. He felt radio was priceless, but that in the Titanic disaster it fell short of its possibilities because of lack of organization and cooperation. Radio is priceless because we would never have known what happened to the Titanic had it not been for wireless. The American Radio Relay League was started in 1918, to help organize the radio amateur and to change the amateur's resentment toward the other services to a spirit of cooperation.

Generally, the enforcing of government regulations and voluntary changes in spirit of various radio services has increased the effectiveness of radio. Today the amount of interference in the spectrum can be attributed to the lack of suitable frequencies for the large number of radio stations now in service. The main solutions to the problems of radio frequency allocations seem to lean toward shifting the amateur bands into the very high frequency range. This would leave the most desirable bands for commercial communications which are more vital than amateur traffic. The present commercial and government stations could then spread out to make less interchannel interference, and allow room for future additions as more stations become necessary. The Federal Communications Commission has already placed Loran in the oldest and lowest frequency amateur band. The Federal Communications Commission has also denied the amateur use of a high frequency band citizen's and industrial short-distance stations have been allocated this band.

Last year the International Telecommunications Conference met in Geneva, bringing together representatives from all countries, to agree on needed changes in the international radio laws. The most significant changes were in the expansion of foreign propaganda broadcast bands at the expense of the iron-curtain countries' amateur radio seven megacycle band, and the allocation of small bands for radio astronomy and space communications. Thus, as we enter the Space Age, it seems inevitable that modifications in the radio laws will aprallel those which made radio more effective after the Titanic disaster.

From school...

to professional achievement

America's colleges and universities give engineering students excellent training in basic disciplines. But this is only a preliminary to a professional career. Future success depends largely upon wise choice of job opportunities. The U. S. Naval Ordnance Laboratory, White Oak, offers young engineers outstanding opportunities . . . *the* opportunities that really count.

In considering *your* job situation, look into training and graduate programs, research and working facilities, challenge of assignments, and professional advancement opportunities. You will be pleased to learn how well a position with the U. S. Naval Ordnance Laboratory, White Oak, meets your needs.

TRAINING PROGRAM OFFERS BREADTH

NOL, White Oak, has a one year rotational training program under which an employee is given four-month assignments in research, engineering, and evaluation departments . . . and a voice concerning assignment upon completion of the program.

ASSIGNMENTS ARE CHALLENGING

Assignments are available in aeroballistics; underwater, air and surface weapons; explosion and chemistry research; physics and applied research; and mathematics . . . and the employee has a voice in selecting the field of his choice even during his training program.

GRADUATE PROGRAM TIES IN WITH SIGNIFICANT PROJECTS

The graduate program, under supervision of the University of Maryland, permits an employee to obtain advanced degrees while working. Many courses are conducted in the Laboratory's own conference rooms, and employees are given generous time to attend these courses. Highly significant projects for theses and dissertations are available, of course.

OPPORTUNITIES FOR PROFESSIONAL ADVANCEMENT

The Laboratory retains patents in employee's name for professional purposes, and for commercial rights in some instances. Attendance at society meetings is encouraged, and there are ample opportunities to engage in foundational research.

EQUIPMENT AND FACILITIES TOP-FLIGHT

The Laboratory has some of the finest equipment available anywhere for research and development work. The Laboratory's location at White Oak, Silver Spring, Maryland is in an attractive and dynamic suburb of Washington, D. C. . . . an atmosphere conducive to the best of living and working conditions.

Position vacancies exist for persons with Bachelor, Master or Doctoral degrees, with or without work experience, at starting salaries ranging from $5,335 to $8,955. These positions are in the career civil service. For additional information, address your inquiry to: Employment Officer, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland, Attention: DPE.

NOL U.S. Naval Ordnance Laboratory

White Oak • Silver Spring, Maryland

Your Placement Office can inform you of the date our representative will visit your school.

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Edited By John Wolfgang

LOW-COST PROXIMITY SWITCH HAS SNAP ACTION, HIGH RELIABILITY

A proximity switch that performs like a standard limit switch and is in the cost range of limit switches has been developed by Tann Corporation.

The Tann switch with micro-sensitive tranducer has snap action, and repeatability within .001 inch.

Differential between on and off position is approximately .008 (unusually low for a proximity switch). Coil spring loaded, the switch maintains high constant pressure and cannot dwell between on and off position. It is shock resistant.

The mechanically simple design is based on a single beam which rocks on a single pivot. The beam is held in place by a magnetic force which is opposed by a coil spring. Because of its simplicity, this switch design may be considered inherently long-lived.

The contacts are rated at 6 amps current at 110 volts resistive load and 3 amps at 220 volts for nominal life, thus requiring no separate power supply. Current ratings for life in millions of cycles are to be announced shortly.

The Tann switch may be actuated by objects travelling either axially or tangentially. With tangential movements, there are no limitations on overtravel.

The switch may also be keyed to a selected contour or an oriented magnet as the actuating device, to permit switching across a larger gap without loss of reliability. However, it is unaffected by random magnetic influences.

COMPACT APPARATUS FOR GENERATING HIGH PRESSURES

A very compact high-pressure apparatus has been designed and built by the National Bureau of Standards to make possible determinations of the properties of materials at high pressures, with the objectives of establishing "fixed points" on the pressure scale, and of devising improved pressure measurement techniques. The instrument can be operated by a conventional hydraulic press. The press forces an anvil downward on one face of a small tetrahedron of pressure-transmitting material. Three other anvils transmit wedge reaction forces from a steel retaining ring to the other faces of the tetrahedron, which functions as a pressure cell. While under pressure in this cell, a specimen may be subjected to resistance heating, or its temperature, electrical resistance, or other quantities can be measured.

MINIATURE PRECISION RESISTOR DEVELOPED

BRADFORD, Pa. — A space-saving 1/4-watt resistor has been introduced by Corning Electronic Components primarily for potted circuits.

The N-12 carries the lowest price in the field of miniaturized precision film resistors, according to the Corning Glass Works department.

Designed for high-density packaging found typically in airborne computers or in missile circuitry, the N-12 meets performance requirements of Mil-R-10509B, Characteristic X. Resistance range is 100 ohms to 133K ohms; voltage rating is 250V; derating is to 140°C.

Standard tolerance is ±1 per cent.

Corning guarantees that average change in resistance will be less than one per cent after 1,000 hours of operation at rated dissipation. Temperature coefficient is guaranteed to be ±.025 per cent change in resistance per degree Centigrade between -55°C and 105°C.

Under military specifications for moisture resistance, typical change in ohmic value is less than one per cent.

The new component is .355-inch long and .131-inch in diameter.

It is non-inductive up to and over 250 megacycles, Corning said.

PLASMA JET ROCK CUTTING

A series of developmental experiments utilizing the new Plasmatron spray depositing device has proven the usefulness of the instrument as a cutting tool for a wide variety of rock formations.

According to Plasmadyne Corporation engineers, developers of the spray gun, the entire cut of granite was completed in less than two seconds. The cutting of the rock is accomplished entirely by the action of the super-heated gases — no abrasive materials are used. In addition to simple cutting, Plasmatron rock cutting is said to be useful in shaping rocks. By using lower gas temperatures, the rocks are actually melted and permitted to flow to desired shapes. The gas pressure can be used to guide the formation of the molten rock.

The Plasmatron guns are being widely used for spray depositing high and low temperature materials such as tungsten, carbides, borides, nitrides, refractory oxides and epoxies.

Mr. Leland W. Sprinkle, Sr., fills the Caverns of Luray, Va., with music as he plays "The Great Stalacpipe Organ" which he invented to derive musical tones directly from Cavern's stalactites. Small threaded rods of Allegheny Ludlum alloy steel are being bolted rigidly through the stalactites, close to tiny wire-wound magnets. When an electronically controlled hammer strikes a stalactite, the combination becomes a tone generator. The organ console is located in the Ballroom of the cavern while the stalactites which serve as organ pipes now range over a three-acre area with expansion to a 64-acre area envisioned. (See Frontispiece).

For the man who likes to make his own career decisions

The Allis-Chalmers Graduate Training Course is based on freedom of opportunity. You will have up to two years of practical training to find the right spot for yourself. At the same time, you enjoy a steady income. You can accept a permanent position at any time — whenever you can show you are ready.

You help plan your own program, working with experienced engineers, many of them graduates of the program. Your choice of fields is as broad as industry itself—for Allis-Chalmers supplies equipment serving numerous growth industries.

A unique aspect of the course is its flexibility. You may start out with a specific field in mind, then discover that your interests and talents lie in another direction. You have the freedom to change your plans at any time while on the course.

Types of jobs: Research • Design • Development • Manufacturing • Application • Sales • Service.

Industries: Agriculture • Cement • Chemical • Construction • Electric Power • Nuclear Power • Paper • Petroleum • Steel.

Equipment: Steam Turbines • Hydraulic Turbines • Switchgear • Transformers • Electronics • Reactors • Kilns • Crushers • Tractors • Earth Movers • Motors • Control • Pumps • Engines: Diesel, Gas.

Freedom of Opportunity opens the doors to challenging and interesting careers. Among them is our Nuclear Power Division, with an engineering staff in Washington, D. C., a new research and development center in Greendale, Wis., and an important research effort at Princeton University involving power from the hydrogen atom. For details on the opportunities available, write to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.

A-1192

ALLIS-CHALMERS AC

Society News

The student chapter of the AIEE-IRE held its last meeting of the year on November 30. Mr. Robert L. Sanborn, a senior Electrical Engineering student at G.W.U., presented a student paper on Design Criteria for Hi-Fi Systems. The ASCE and ASME held their meetings on December 7. The speaker for the ASCE meeting was Charles Conrad of NCPC, who spoke on the Southwest Urban Renewal. The ASME showed three films on Nuclear Energy and Power Reactors in the U.S.A. The next meeting of the AIEE-IRE will be held on January 4, and the speaker will be Mr. Doctor of DOFL. His topic will be Micro-Miniaturization. The MECHELECIV as well as the engineering societies will announce the time and place of regional and national student paper contests, which are held annually during the spring semester.

Engineer's Council

The engineer's council reports that the engineering school has sponsored five Christmas trees, which are placed at various points on Campus. Support the tree of your choice this Christmas.

Sigma Tau

The 1960 biannual conclave of the Sigma Tau Fraternity was held on the third, fourth and fifth of November at Colorado State University at Fort Collins, Colorado, Alpha-Alpha Chapter of that University being the host chapter. This meeting was a complete success, being attended by six national officers and 32 delegates along with several unofficial representatives from closely located chapters. Among other entertainment, the delegates enjoyed a tour of the Great Western Sugar Factory at Loveland, Colorado on the evening of November third.

One of the more constructive activities by a chapter of Sigma Tau was reported by Upsilon Chapter of the University of Florida. This chapter, during the past year, has been compiling a complete list of all scholarships available to university students. This activity is eminently worthwhile; the completed work will certainly be of distinct value, not only to prospective recipients, but also to the Universities where the information is available.

Xi Chapter of George Washington was represented by Bernard Schuler, the president of this chapter.

If your sights are set  on astro-electronics–

Photo from screen of RCA's TV Imagery Simulator. This device permits electronics to enhance photographs to aid interpreters. It was used in the design of TIROS I, developed for the National Aeronautics and Space Administration by RCA, to simulate photographs which could be obtained from 400 miles in space.

–you'll find **Photography at Work** with you

Outer space presents vast new challenges to the engineer—especially in electronics. And photography becomes one of his valuable tools. Orbiting satellites send messages to be recorded from the oscilloscope tube. X-rays and film allow him to check the internal integrity of sealed components. Even intricate circuits can be printed and miniaturized by photographic methods.

There's hardly a field on which you can set your sights where photography does not play a part in improving the product, simplifying work and routine. It saves time and costs in research, on the production line, in quality control, in the engineering and sales departments, in the office.

So in whatever you plan to do, take full advantage of all the ways photography can help.

CAREERS WITH KODAK:

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design, sales, and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N.Y.

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Kodak
TRADE MARK

One of a series

Interview with
General Electric's Byron A. Case
Manager—Employee Compensation Service

Your Salary at General Electric

Several surveys indicate that salary is not the primary contributor to job satisfaction. Nevertheless, salary considerations will certainly play a big part in your evaluation of career opportunities. Perhaps an insight into the salary policies of a large employer of engineers like General Electric will help you focus your personal salary objectives.

Salary—a most individual and personal aspect of your job—is difficult to discuss in general terms. While recognizing this, Mr. Case has tried answering as directly as possible some of your questions concerning salary:

Q Mr. Case, what starting salary does your company pay graduate engineers?

A Well, you know as well as I that graduates' starting salaries are greatly influenced by the current demand for engineering talent. This demand establishes a range of "going rates" for engineering graduates which is no doubt widely known on your campus. Because General Electric seeks outstanding men, G-E starting salaries for these candidates lie in the upper part of the range of "going rates." And within General Electric's range of starting salaries, each candidate's ability and potential are carefully evaluated to determine his individual starting salary.

Q How do you go about evaluating my ability and potential value to your company?

A We evaluate each individual in the light of information available to us: type of degree; demonstrated scholarship; extra-curricular contributions; work experience; and personal qualities as appraised by interviewers and faculty members. These considerations determine where within G.E.'s current salary range the engineer's starting salary will be established.

Q When could I expect my first salary increase from General Electric and how much would it be?

A Whether a man is recruited for a specific job or for one of the principal training programs for engineers—the Engineering and Science Program, the Manufacturing Training Program, or the Technical Marketing Program—his individual performance and salary are reviewed at least once a year.

For engineers one year out of college, our recent experience indicates a first-year salary increase between 6 and 15 percent. This percentage spread reflects the individual's job performance and his demonstrated capacity to do more difficult work. So you see, salary adjustments reflect individual performance even at the earliest stages of professional development. And this emphasis on performance increases as experience and general competence increase.

Q How much can I expect to be making after five years with General Electric?

A As I just mentioned, ability has a sharply increasing influence on your salary, so you have a great deal of personal control over the answer to your question.

It may be helpful to look at the current salaries of all General Electric technical-college graduates who received their bachelor's degrees in 1954 (and now have five years' experience). Their current median salary, reflecting both merit and economic changes, is about 70 percent above the 1954 median starting rate. Current salaries for outstanding engineers from this class are more than double the 1954 median starting rates and, in some cases, are three or four times as great.

Q What kinds of benefit programs does your company offer, Mr. Case?

A Since I must be brief, I shall merely outline the many General Electric employee benefit programs. These include a liberal pension plan, insurance plans, an emergency aid plan, employee discounts, and educational assistance programs.

The General Electric Insurance Plan has been widely hailed as a "pace setter" in American industry. In addition to helping employees and their families meet ordinary medical expenses, the Plan also affords protection against the expenses of "catastrophic" accidents and illnesses which can wipe out personal savings and put a family deeply in debt. Additional coverages include life insurance, accidental death insurance, and maternity benefits.

Our newest plan is the Savings and Security Program which permits employees to invest up to six percent of their earnings in U.S. Savings Bonds or in combinations of Bonds and General Electric stock. These savings are supplemented by a Company Proportionate Payment equal to *50 percent* of the employee's investment, subject to a prescribed holding period.

If you would like a reprint of an informative article entitled, "How to Evaluate Job Offers" by Dr. L. E. Saline, write to Section 959-14, General Electric Co., Schenectady 5, New York.

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